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Beyond Food Security: Developing a Food Stress Index in Austin, Texas

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Beyond Food Security: Developing a Food Stress Index in Austin, Texas

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Abstract

Beyond Food Security: Developing a Food Stress Index in Austin, Texas

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Food insecurity and food access are ongoing concerns in Austin, Texas, particularly given rapid changes in population and demographics over the past decade. Food insecurity metrics in the United States are reliable but may be insufficient to capture the changing environment within a city on a neighborhood basis. Food stress, similar to housing stress, occurs when a household spends a significant share of its income on food. Households facing food stress are more likely to be at risk of food insecurity. The Food Stress Index (FSI) identifies areas in Austin, Texas where households are most likely to face food stress, based on household demographics and environmental factors. Principal component analysis (PCA) was used to reduce a set of candidate variables and calculate a Food Stress Index score at the census tract level for Austin/Travis County. The results are compared to the City of Austin's Food Environment Analysis, which identifies areas facing multiple barriers to accessing healthy, affordable, and culturally appropriate food. Food Stress Index scores can be recalculated in the future with updated data to reflect the changing environment in Austin. The Food Stress Index may be used to identify areas of opportunity to address food access, food insecurity, and poverty through policy interventions.

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BACKGROUND

What is Food Insecurity?

In the broadest sense, food security exists when "all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life."[1] This definition, first established at the 1996 World Food Summit of the United Nations Food and Agriculture Organization (U.N. FAO) and since updated, is most often used as the international standard for food security work. Under this working definition, food security has four dimensions: availability, access, utilization, and stability.[2] Food insecurity, by contrast, occurs when *any* of these conditions are not met. Availability refers to the quantity in the food supply, while access refers to individuals' ability to acquire food when it is available; access can be economic (food is affordable), physical (people can obtain available food), or social (food is available regardless of social status or other cultural delineations). Utilization refers to the uptake of food (for example, food must be sanitary and safe for consumption), and stability means that people have a reasonable expectation of these criteria being met.[3]

In the United States, the U.S. Department of Agriculture (USDA) defines household food insecurity as "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways."[4] This definition clearly includes availability and access; in the U.S., food security primarily depends on the ability of households to access food, either economically or physically, given that the U.S. does not face clear food shortages that may occur at a national scale in other countries. Access to food is therefore a key component of food security in the United States, including factors such as household purchasing power and the food environment.[5] USDA reports that 11.1 percent of U.S. households faced food insecurity at some point during the year in 2018.[6] Single-parent households, black and/or Hispanic households, households with children, and low-income households have a higher prevalence of food insecurity when compared to the U.S. average.[7]

Food Insecurity and Poverty

Though there is a strong relationship between food security and poverty, one does not necessarily imply the other; many households that are food insecure live above the poverty line, and most households earning near the poverty level are not food insecure.[8,9,10] Other household and environmental characteristics must be evaluated to assess household propensity for food insecurity. Research indicates that broader economic factors are associated with food insecurity rates, including unemployment, inflation, and the relative price of food.[11] At the household level, other socio-economic characteristics are associated with a household's food security status; median household income, household size, age, household composition (single-parent families, presence of disabled family members, etc.), race, education and home ownership have all been found to be significantly associated with the likelihood of food insecurity.[12,13,14] Household financial characteristics, such as human capital and financial assets, may play an important role in determining a household's food security status, as these characteristics can affect a household's resilience to economic changes.[15] Generally, low-income households and households in poverty are more likely to be food insecure; research indicates that probability of food insecurity increases as household income decreases.[16]

Food Insecurity and Health

As with poverty, the relationship between food insecurity and health outcomes is well-documented for children, adults, and seniors.[17] Food insecurity is associated with a decrease in fruit and vegetable consumption and consequent nutrient intake.[18,19,20,21] Health outcomes for food-insecure children are of particular interest; food insecurity poses a risk to cognitive and behavioral development, and children who are food insecure are two times more likely to be in poor health when compared to children who are not food insecure.[22,23] Food insecurity also is associated with poorer health in adults, particularly for women and in conjunction with race.[24,25] The health implications of food security may vary in severity, but even marginally food insecure households face heightened health risks.[26] Food insecurity in the United States is a fundamental equity concern given its tangible and negative impacts for certain populations.

Food Insecurity Metrics in the United States

Two readily available sources of information about food insecurity in the United States are USDA and, more recently, Feeding America. These two organizations examine food insecurity using different methodologies and scopes. USDA reports food insecurity rates at the national and state levels on an annual basis. The agency has been formally measuring food security in the United States since 1995 using the Food Security Supplement (FSS), an addendum to the Current Population Survey (CPS).[27] The Food Security Supplement is an experiential metric, capturing households that self-report behaviors and experiences consistent with food insecurity, such as food pantry usage and household expenditures on food.[28] While this metric is valid,[29] FSS data are not released at the local level due to concerns about sample size. Consequently, USDA data are primarily useful for capturing trends in food insecurity at a high level but are not particularly informative for local geographies.

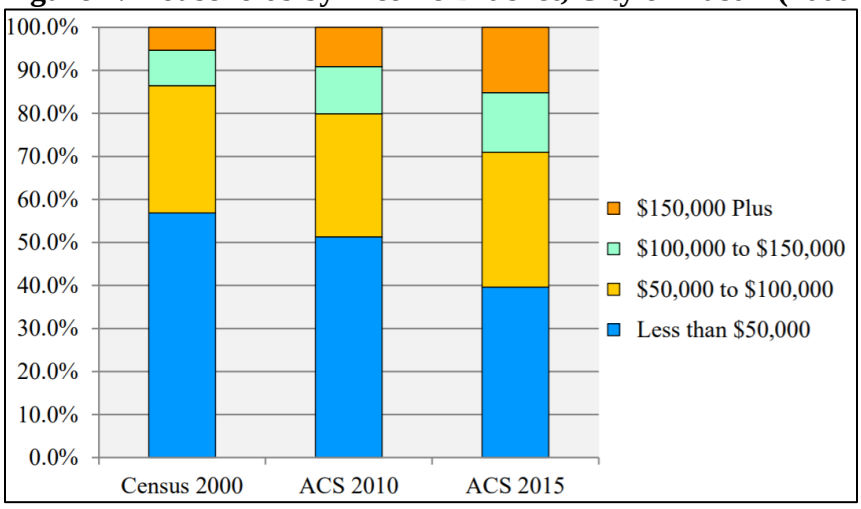
Feeding America is a national non-profit organization representing food banks and charitable feeding organizations across the county. The organization coordinates between food banks, donors, and clients who utilize food bank services, in addition to producing research and organizing anti-hunger advocacy efforts.[30] Researchers at Feeding America release an annual "Map the Meal Gap" study in which food insecurity rates are estimated at multiple geographies using statistical modelling.[31] Feeding America uses data from the Current Population Survey and the American Community Survey to estimate the share of households that are likely to experience food insecurity each year; these model-based estimates are available at the state, county, and census tract level. CPS data are used to calculate the food insecurity rate at the state level, while ACS data are used to estimate the food insecurity rate at the sub-state level using statistical modelling.[32,33] Feeding America also calculates food insecurity rates for each congressional district, a feature consistent with their work advocating for a clearly defined anti-hunger policy agenda at multiple levels of government.

These two metrics represent an experiential and a predictive approach, respectively, to tracking food insecurity in the United States. In the absence of a localized metric based on survey responses, model-based estimates are used in the development of a local Food Stress Index.

Food Insecurity and Food Access in Austin, Texas

Austin is the capital city of Texas and is geographically located in the central region of the state. In 2019, there are just under one million people living within city limits, though the metropolitan statistical area (MSA) is home to approximately 2.2 million residents.[34] The median household income for the city was $67,755 in 2017, higher than the U.S. median of $61,372.[35,36] Approximately one third of the population is Hispanic or Latino, and nine percent of city residents are black.[37] Austin has experienced significant growth since the early 2000s; the population in 2000 was only 656,652, and the annual growth rate has typically fluctuated between two and three percent before slowing to 1.9 percent in 2018.[38] Income inequality has increased along with population size. Not only has median household income significantly increased from $50,132 in 2010, but the share of households in the highest income bracket (earning over $150,000 per year) increased between 2000 and 2015, while the share of households in the lowest income bracket (earning less than $50,000) has shrunk, in both the Austin MSA and in the city itself.[39,40] In 2017, 13.1 percent of Austin residents lived below the poverty line, a prevalence higher than the U.S. poverty rate of 12.3 percent in the same year.[41,42] Though the City of Austin and Travis County often are conflated, the city's boundaries span Travis, Williamson, and Hays Counties. Feeding America's 2018 estimates for the food insecurity rate in each county were 14.6 percent (Travis), 12.5 percent (Williamson), and 13.2 percent (Hays).[43]

Figure 1: Households by Income Bracket, City of Austin (2000 to 2015)[44]



Efforts to combat food insecurity at the local level in Austin focus primarily on increasing access to healthy, affordable, and culturally appropriate foods. Healthy food refers to the nutritional adequacy component of food security, while affordable refers to economic access. Cultural appropriateness of food refers to the acceptability condition of food security. In practice, having access to culturally appropriate food means that residents can acquire foods that meet their desired dietary traditions and shop for food in safe environments consistent with their cultural and language-specific communities. Food access efforts in Austin address both physical and economic access by increasing the availability of healthy, affordable foods through mechanisms that meet the needs of specific communities. In 2017, the Austin Healthy Food Access Initiative was launched in response to a City Council resolution directing city staff to develop a comprehensive strategy for improving food access throughout the city.[45] The resulting initiative includes a set of six strategies addressing multiple barriers to accessing healthy, affordable, and culturally appropriate food.[46] This comprehensive set of strategies involves interdepartmental city staff, local nonprofits, community based organizations, and other external stakeholders.

Table 1: Austin Healthy Food Access Initiative, Strategies to Improve Food Access

Strategy	Description	Targeted Dimension
Food Environment Analysis	*A geographic/spatial analysis of barriers to healthy, affordable food*	Economic, physical
Local Food Production	*Policies that encourage urban agriculture, including community gardens and urban farms*	Physical
SNAP Outreach and Enrollment	*Increasing SNAP enrollment to close the gap between the share of the population that is eligible vs. enrolled for food assistance*	Economic
Fresh for Less	*Subsidized retail outlets providing access to fresh produce and staple foods in targeted neighborhoods*	Economic, physical
Safe Routes to Markets	*Addressing transportation barriers to food retail and/or food access points*	Physical
Nutritious Food Incentive Program	*Pilot allowing subsidized purchases of locally grown produce in traditional food retail outlets*	Economic

The City of Austin's Food Environment Analysis (FEA), conducted in 2017 and published in 2019, examines four specific barriers to food access: income, food retail availability, proximity to healthy food retail, and vehicle access. Through a combination of primary data collection and ACS data, the FEA identifies at the neighborhood (census block group) level which areas of the city face the highest barriers to accessing healthy food.[47] Accompanying data visualizations

highlight the geographic disparities in food access[48]; areas facing the highest barriers are primarily located in the East side of the city, where historically incomes tend to be lower and Hispanic and African-American populations have been concentrated.[49,50,51]

Figure 2: Food Environment Analysis, Barriers to Accessing Healthy Food, 2017[52]

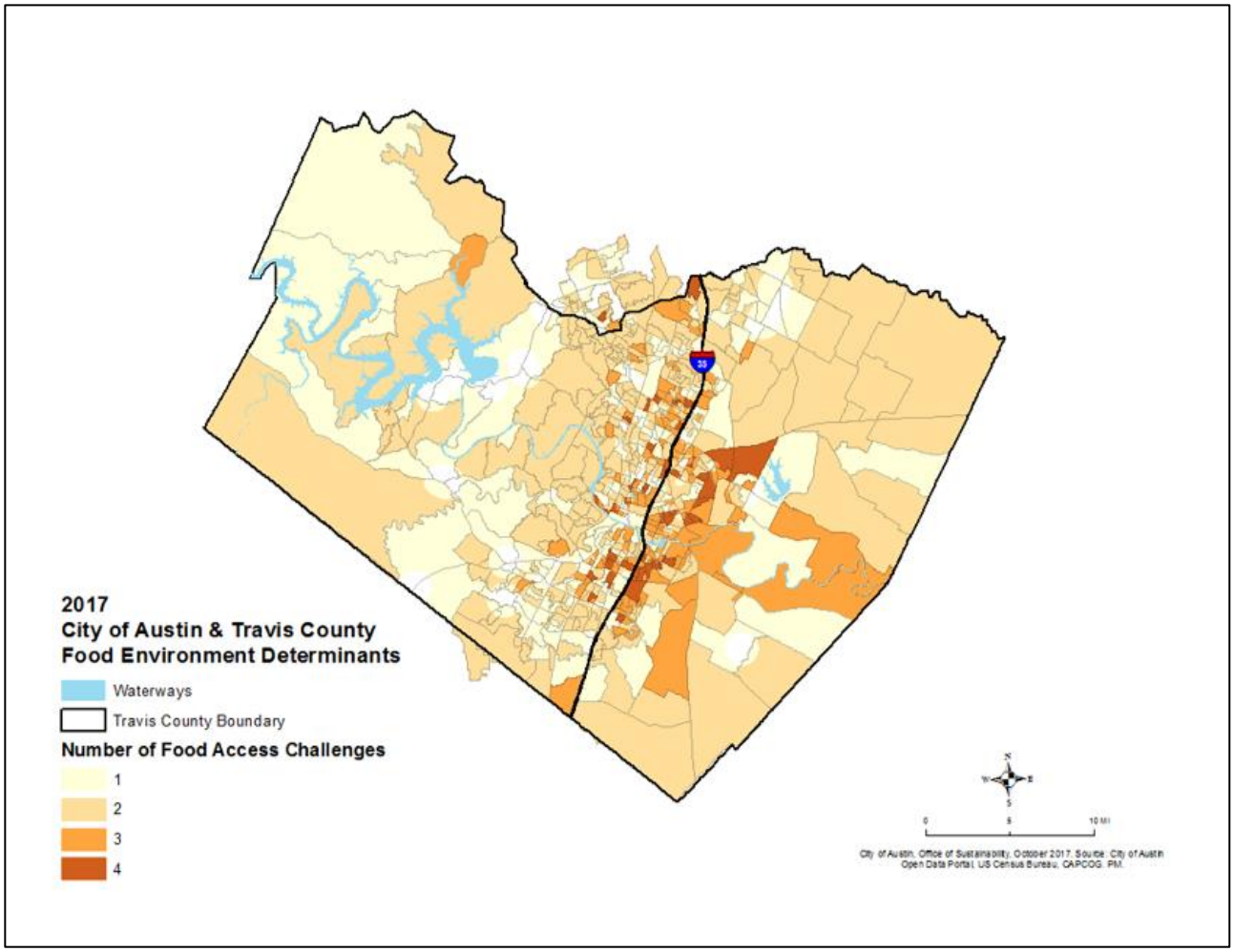


Figure 3: Median Family Income, 2015[53]

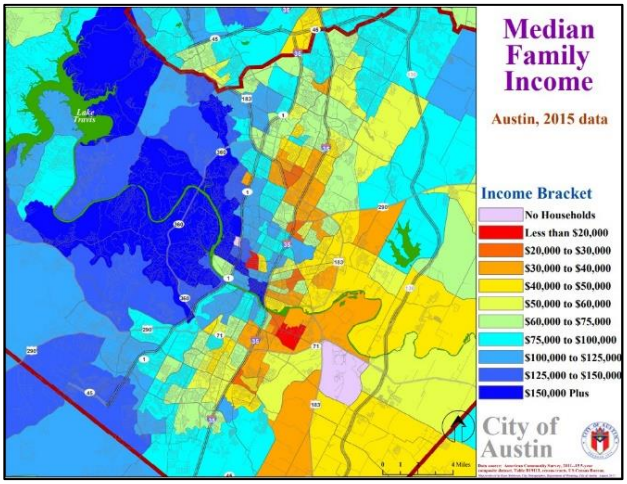


Figure 4: Poverty Rate, 2015[54]

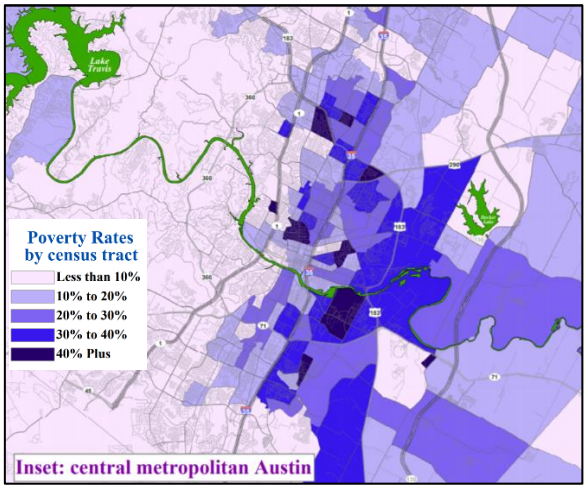


Figure 5: African American Population, 2010[55]

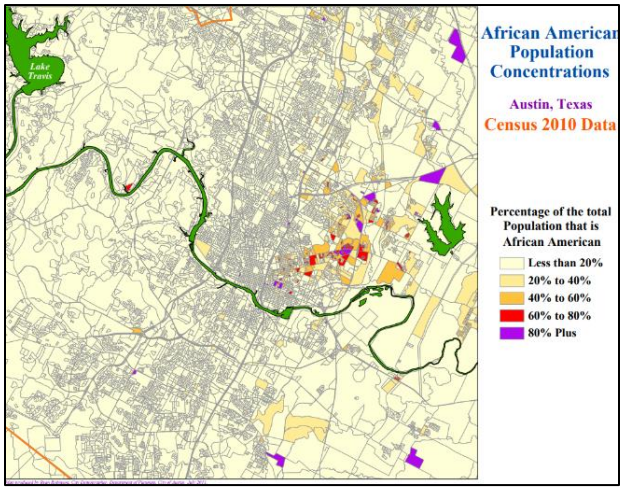
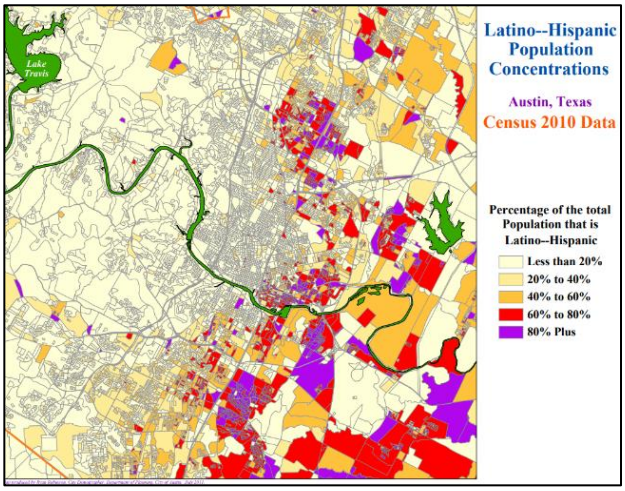
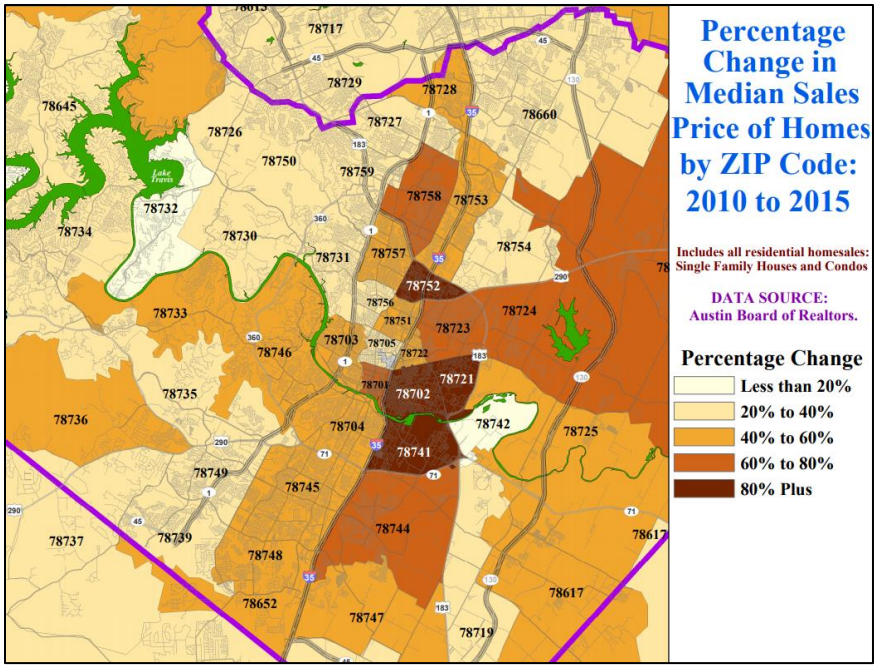


Figure 6: Hispanic Population, 2010[56]



The geographic and racial disparity in access to healthy food represents an underlying inequity in Austin's food system, and it reflects trends in the geographic distribution of wealth and opportunity. Gentrification and displacement have become major concerns for the city and for organizations working to combat poverty and food insecurity. Rapid population growth has magnified existing inequities related to food access, health, and economic opportunity, as areas with the highest concentration of poverty and non-white residents are experiencing the greatest levels of population growth and increases in housing values.[57,58,59,60]

Figure 7: Percent Change in Median Home Sales Price, 2010 to 2015[61]



Understanding the geographic distribution of opportunity within Austin is essential to developing targeted approaches to improving food access for specific communities. The Food Environment Analysis provides a neighborhood level assessment of food availability and addresses both physical and economic dimensions of food access. However, the FEA does not include neighborhood composition or other factors related to household expenditures. The FEA identifies important barriers to food access, but its findings must be interpreted within the context of other information to understand exactly which communities are at greatest risk of food insecurity.

An Alternative Metric to Food Insecurity

Based on the limitations of existing food insecurity metrics, a localized indicator that captures factors specific to the region would be particularly useful to inform policymaking and advocacy related to food access in Austin. The ideal indicator would capture multiple dimensions of food security, as well as factors that affect a household's ability to purchase healthy, affordable, and culturally appropriate foods – including health, housing, and transportation. Food insecurity rate as a single metric is easy to communicate and is generally understood across multiple audiences; the ideal metric would be similarly straightforward and could be used for comparison across

multiple geographies, particularly at the neighborhood level, to capture geographic disparities within a rapidly changing city.

A Food Stress Index

The concept of housing stress is used to describe a situation in which a household or family spends a significant share of its income on housing costs, and/or experiences financial difficulty finding adequate housing.[62] Though not comprehensive, a general rule of thumb is that housing should constitute thirty percent or less of a household's budget to be considered affordable.[63] Food stress can be thought of as a similar concept, or a situation in which a household must spend a disproportionate share of its income in order to purchase a healthy diet. The Supplemental Nutrition Assistance Program (SNAP, formerly known as food stamps) uses the same threshold in its benefit calculation formula; a household's anticipated contribution to food is thirty percent of its income.[64] Low-income Americans may struggle with balancing household expenditures on a limited budget, forcing households to make tradeoffs between basic needs.[65,66] Low-income households must already spend a larger share of their income in order to access healthy and desirable food.[67] However, food often is the least fixed cost when compared to other necessities, such as housing and medicine, and is therefore often the first necessity on which households will reduce spending.[68,69,70,71] For example, rent is fixed for a lease term, but a family can purchase fewer or cheaper groceries and visit a food pantry in the event of a budget shortfall. When faced with budgetary challenges, households often spend less on food, opting to purchase cheaper and less healthy items.[72] Households facing food stress are likely to face a higher risk of being (or becoming) food insecure, if budget shortfalls or unforeseen circumstances require a household to reduce its spending on food. Food insecure households and women in particular may resort to food-coping mechanisms when faced with budgetary constraints.[73,74,75]

A Food Stress Index combines the localized lens of the Food Environment Analysis with the usefulness of a single metric that the food insecurity rate provides, building on both approaches by including household specific and neighborhood/environmental factors. An index captures multiple dimensions of food insecurity and allows for direct comparison between neighborhoods. The goal of developing a Food Stress Index is to identify areas with the highest propensity for

food stress and, as a result, the highest risk of being or becoming food insecure for any given amount of time.

METHODOLOGY

The methodology for developing a Food Stress Index in Austin/Travis County at the census tract level was drawn from the approach used by Landrigan, et al. in Western Australia.[76] Data sources and unit of analysis were adapted to a U.S. context, and several additional candidate variables were included to capture factors specifically relevant to food access and food insecurity in Austin, Texas. All statistical analysis was conducted using Stata 16.0.

Scope

There were 233 census tracts identified as being within or partially within Travis County and/or Austin city limits (including Williamson and Hays Counties). Seven census tracts were removed initially from the analysis due to low population counts or populations that are not representative of typical Austin residents (i.e. undergraduate college students). Food insecurity/hunger among college students is a significant problem, but one that should be addressed in its own analysis rather than comparing this geographically concentrated population to others in Austin. The following census tracts were removed from the analysis altogether.

Table 2: Census Tracts Removed from Analysis

Census Tract ID	Description of area
980000 002319	Austin Bergstrom International Airport
001308	St. Edwards University
000601 000603 000604	University of Texas at Austin and surrounding student neighborhoods
001606	Low population estimate

Food Insecurity Estimates

Feeding America's "Map the Meal Gap" 2019 estimates for food insecurity rate were used to validate and develop the Food Stress Index. Feeding America uses a set of factors drawn from ACS Census Data and Bureau of Labor Statistics unemployment data to calculate an estimate of the food insecurity rate for multiple geographies through regression analysis.[77] Census tract estimates were used for the Food Stress Index.[78] Table 3 summarizes the variables used by Feeding America to estimate food insecurity rates for the remaining Austin/Travis County census tracts (n=226).

Table 3: Factors Used to Predict Food Insecurity, Austin/Travis County Census Tracts

Variable	Mean	Standard Deviation	Data Source
Estimated food insecurity rate	.1516	.0447	Feeding America
Percent black	.0867	.0863	ACS Census Data
Percent Hispanic	.3187	.2117	ACS Census Data
Percent home ownership	.5274	.2520	ACS Census Data
Median household income	74,810	33,664	ACS Census Data
Poverty rate	.1336	.1034	ACS Census Data
Unemployment rate	.0438	.0237	Bureau of Labor Statistics

Description of Candidate Variables

Candidate variables were drawn or calculated at the census tract level for the Austin/Travis County region. Based on existing literature, variables were chosen to capture demographic factors, household expenditures, and factors related to both economic and physical access to food. Candidate variables fall into four categories: households and families, housing, health, and food access. Household and family variables include information about household composition and socio-economic characteristics. Health and housing represent other basic necessities that may compete with food expenditures in household budgetary decisions. Food access variables capture the cost of food, the food environment, and use of nutrition assistance. The individual variables used in Feeding America's food insecurity estimates were later used to calculate the final index.

Table 4: Dimensions of Food Stress and Associated Indicators

Dimension	Chosen Indicators
Households and Families	Age Household size Single-parent families Education Income inequality
Housing	Rent Home value Housing stability Vehicle Access
Health	Health insurance Disability status
Food Access	Food retail availability Food affordability SNAP

Summary of Candidate Variables

Candidate variables were drawn and/or calculated from ACS Census data (using 2017 5-year estimates), USDA cost of food estimates, and primary data collection from the City of Austin's Food Environment Analysis. The initial set of candidate variables is intended as a broad range of factors that may be related to food insecurity, food access, and food stress; this set was reduced in the next step of the analysis. Table 5 summarizes the initial set of candidate variables.

Reducing Candidate Variables

Regression analysis was used to identify which factors would be included in the reduced set of candidate variables. Each variable was reported as a proportion and was first standardized to a mean of 0 and a standard deviation of 1. Feeding America's food insecurity rate was used as the dependent variable and was regressed on the complete set of standardized candidate variables. Missing observations were dropped from the analysis prior to performing the regression.

Figure 8

$$FI_{ct} = \alpha + \beta_{age}AGE + \beta_{hhsize}HHSIZE + \beta_{singlepar}SINGLEPAR + \beta_{uninsured}UNINSURED + \beta_{rent}RENT + \beta_{homeval}HOMEVAL + \beta_{samehouse}SAMEHOUSE + \beta_{college}COLLEGE + \beta_{foodret}FOODRET + \beta_{disabled}DISABLED + \beta_{housecost}HOUSECOST + \beta_{novehic}NOVEHIC + \beta_{foodafford}FOODAFFORD + \beta_{snap}SNAP + \varepsilon_{ct}$$

Variables that appeared to have a statistically significant association with food insecurity at a 10 percent significance level or higher were included in the reduced set of candidate variables.

Table 5: Summary of Candidate Variables, by Dimension of Food Stress

Dimension	Variable	Description	n	Mean	Standard Deviation	Data Source
Households and Families	Median Age	Median age of the population	226	35.48	5.77	ACS Census Data
	Household size	Average number of members in a household	226	2.57	.5406	ACS Census Data
	Single-parent families	Share of households that are single-parent families	226	.1462	.0823	ACS Census Data
	Education	Share of the population 25 years and older with at least a bachelor's degree	226	.4802	.2160	ACS Census Data
	Income inequality	Ratio of aggregate wealth held by top quintile of earners to bottom quintile	225	13.47	10.91	ACS Census Data
Housing	Rent	Median gross monthly rent	225	1276.68	324.05	ACS Census Data
	Housing value	Median value of owner-occupied housing units	221	311,243	177,422	ACS Census Data
	Housing stability	Share of households that lived in the same house one year prior	226	.8064	.0960	ACS Census Data
	Total housing costs	Median monthly housing costs	226	1397.06	448.58	ACS Census Data
Health	Disability status	Share of the population with a disability	226	.0898	.0339	ACS Census Data
	Health insurance	Share of the population without health insurance	226	.1424	.0958	ACS Census Data
Food Access	Vehicle access	Share of households without access to a vehicle	226	.0555	.0503	ACS Census Data
	Food affordability	Share of median income needed to purchase a healthy food basket for the average household	226	.1185	.0569	ACS Census Data; USDA Cost of Food Plans
	Food retail availability	Number of food retailers	226	4.13	3.38	City of Austin, Office of Sustainability Food Environment Analysis

Table 6: Reduced Set of Candidate Variables, by Dimension of Food Stress

Dimension	Candidate Variables – Reduced Set
Households and families	Average household size Percent of households that are single parent families Percent of population 25 years and older with at least a bachelors' degree
Housing	Median gross rent Percent of households that lived in the same house one year ago
Health	Percent of population without health insurance
Food Access	Food affordability ratio

In addition to the reduced set of variables shown in Table 6, the six component variables used to calculate Feeding America's food insecurity estimate (see Table 3) were included individually in the analysis. As predictive components of food insecurity, these variables also are important indicators of food stress. Each candidate variable in the reduced set had a significant association with the combined food insecurity estimate, but may be associated with component variables at a varying rate; breaking down the food insecurity estimate into individual variables allows for a parceling out of the factors that account for the most variance in the data. Table 7 details all candidate variables included in the analysis and corresponding dimensions of food stress.

Table 7: Total Candidate Variables Included in Analysis, by Dimension of Food Stress

Dimension	Variable
Households and families	Average household size Percent of households that are single parent families Percent of population 25 years and older with at least a bachelors' degree Percent of households that are black Percent of households that are Hispanic, any race Unemployment rate Poverty rate
Housing	Median gross rent Percent of households that lived in the same house one year ago Percent of households that own their home
Health	Percent of population without health insurance
Food Access	Food affordability ratio Median household income

This set of variables was reduced further using principal component analysis to determine a final set of variables used to calculate Food Stress Index scores.

Principal Component Analysis

Principal component analysis (PCA) is a methodology used to reduce a set of potentially correlated variables into a smaller set; the first principal component accounts for most of the

variance in the data, and so on. By removing correlated variables, PCA results in a smaller set of uncorrelated variables that capture as much of the variance in the initial data as possible.[79] PCA was conducted on the reduced set of candidate variables to produce a final set, which were then weighted and used to calculate raw index scores for each census tract.

After the first round of analysis, variables with loadings lower than 0.3 (in terms of absolute value) on the first principal component were removed, consistent with the protocol established by Landrigan, et al. PCA was conducted until all remaining variables returned loadings on the first principal component with an absolute value greater than 0.3, resulting in a final set of variables used to calculate the Food Stress Index. It is surprising that the final set of variables did not include any indicators representing housing costs; however, income and poverty are represented in the final index variables, capturing household financial characteristics, which are likely related to expenditures on basic necessities, including housing.

Table 8: Final Set of Variables, by Dimension of Food Stress

Dimension	Variables – Final Set	Association with Food Stress
Households and families	Percent of households that are Hispanic, any race	+
	Percent of households that are single-parent families	+
	Percent of population 25 years and older with at least a bachelors' degree	-
	Poverty rate	+
Health	Percent of population without health insurance	+
Food Access	Food affordability ratio	+
	Median household income	-

The final set of variables was used to calculate the index scores for each census tract, using the formula outlined by Landrigan, et al. Weights were calculated for each variable, dividing the loading by the square root of the eigenvalue. The value of each standardized variable was then multiplied by its weight. Finally, the weighted values for each variable were added up for each census tract, returning a raw index score for each tract. To determine the direction of the effect of each variable on the likelihood of food stress, food insecurity was correlated with and regressed on each variable individually. The sign of the respective r-value and regression coefficient indicated whether that variable likely has a positive or negative association with propensity for food insecurity and/or food stress, and the resulting sign was used accordingly when summing

variables to calculate the raw index score. The direction of correlation and regression coefficients were in agreement for each of the seven variables. Finally, raw index scores were scaled to a mean of 1000 and standard deviation of 100. This step was drawn from the protocol used by Landrigan, et al and makes the index scores easier to understand, particularly when ranking census tracts from most to least likely to experience food stress.

RESULTS AND ANALYSIS

Results

Food Stress Index scores were calculated for 226 census tracts in the Austin/Travis County region. Scores ranged from 858.9 to 1297.7. The median score was 962.7, lower than the mean of 1000, indicating that the distribution of scores is skewed left. The mean food insecurity rate in tracts above the median FSI score was 16.3 percent, significantly higher than the mean food insecurity rate for tracts below the median FSI score (14 percent) at a 1 percent level. Disparities are even more stark when comparing the mean values for tracts with the highest and the lowest scores. Simple hypothesis testing was used to compare mean characteristics of tracts scoring in the top and bottom quartiles.

Table 9: Tracts with Food Stress Index Scores in the Top and Bottom Quartile

	Top Quartile	Bottom Quartile
Food Insecurity Rate (%)	16.75	13.99
Share of Households Receiving SNAP (%)	20.1	2.73
Black Population (%)	13.99	3.9
Median Household Income ($)	$45,570	$89,149
Poverty Rate (%)	25.88	5.69

Census tracts with the highest FSI scores – those with the highest propensity for food stress and risk of food insecurity – tend to have greater non-white populations, lower incomes, and higher rates of poverty and food insecurity.

Food Stress Index Scores and the Food Environment Analysis

The City of Austin's Food Environment Analysis (FEA) identifies geographic areas at the census block group level that face four specific barriers to food access: low household income, limited food retail availability, limited proximity to healthy food retail, and limited vehicle access. The FEA focuses on census block groups facing all four barriers – sometimes referred to as "healthy food priority areas."[80] Although the FEA was conducted at the block group level, healthy food priority areas can be overlayed with Food Stress Index scores for census tracts in Austin/Travis County.

Figure 9: Food Stress Index and the Food Environment Analysis[81]

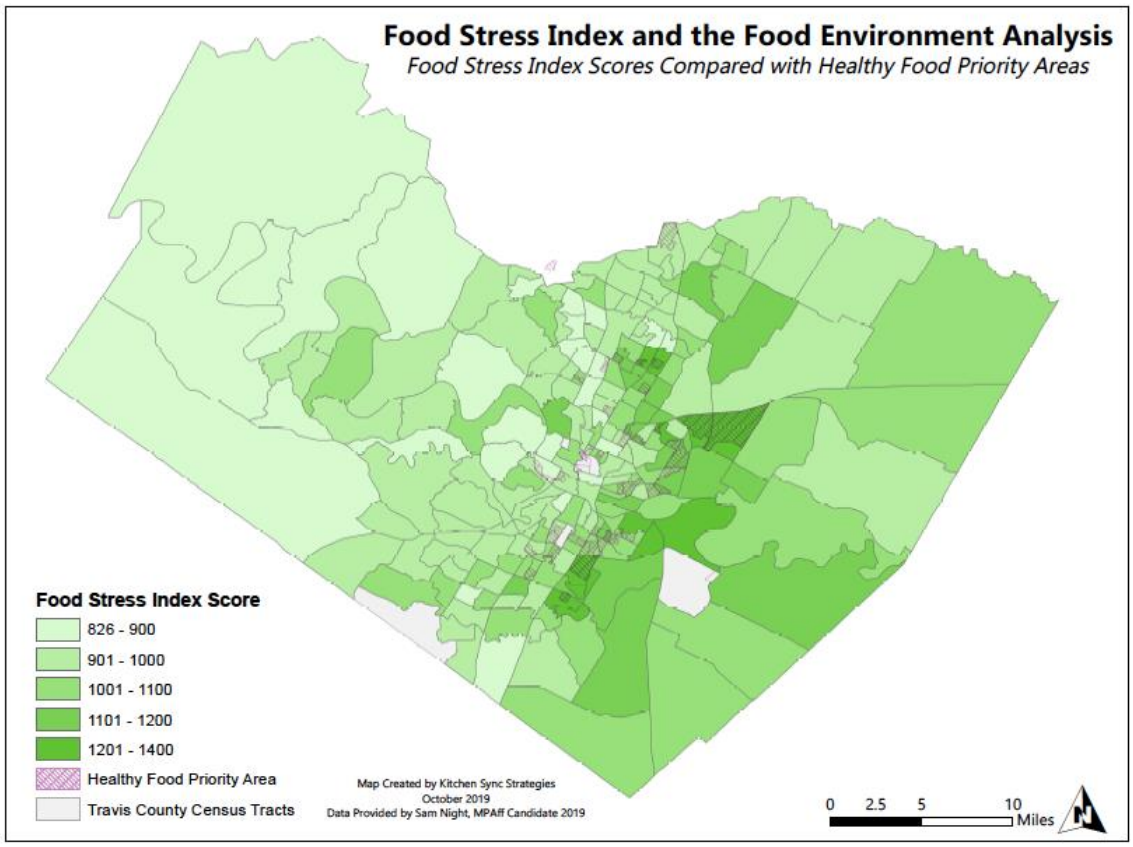
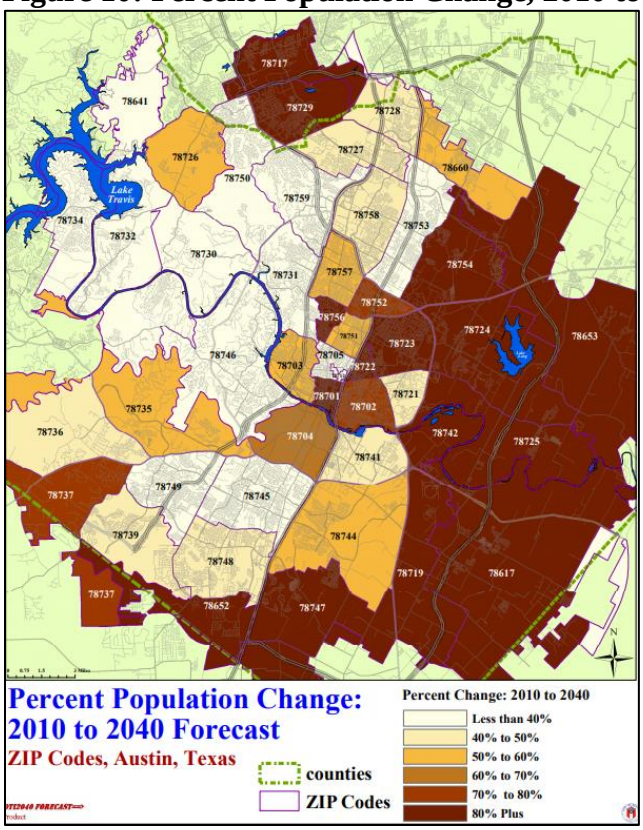


Figure 8 displays the geographic distribution of food stress in Austin/Travis County. Scores appear to be generally higher on the Eastern side of the city, indicating a higher propensity for food stress and risk of food insecurity in these neighborhoods. This finding is consistent with the location of healthy food priority areas, shown in a cross-hatch pattern; populations facing highest propensity for food stress also face the greatest barriers to accessing healthy food. Populations facing higher propensity of food stress are also located in areas of the city facing the greatest levels of gentrification, development, and resulting potential for displacement. These areas are projected to see the highest rates of population growth, increasing the likelihood of continued development and risk of displacement.

Figure 10: Percent Population Change, 2010 to 2040 Forecast[82]



Food Stress Index results support existing research and anecdotal evidence from program operations and community engagement, indicating that households in the Eastern side of Austin/Travis County face a complex and disproportionate set of barriers to food access, propensity for food stress and consequent food insecurity, and potential for displacement.

Contextualizing the Food Stress Index: Social Vulnerability

The U.S. Centers for Disease Control and Prevention (CDC) calculates and publishes a Social Vulnerability Index (SVI) using fifteen census variables to indicate community health resilience.[83] CDC defines social vulnerability as a combination of "factors…that may weaken a community's ability to prevent human suffering and financial loss in a disaster."[84] Social vulnerability is an indicator of a community's financial resilience and ability to respond to unforeseen circumstances. SVI scores are available at the census tract level, published on an annual basis by the CDC. When comparing the Food Stress Index to the Social Vulnerability Index, scores for the two indices in Austin/Travis County were positively correlated for all

census tracts (r=0.7818), indicating that areas facing high food stress according to this analysis are also more likely to face financial instability.[85] Food stress and social vulnerability both capture the impact of poverty on communities and highlight the wealth inequities in Austin. Areas with high FSI and SVI scores may be considered priority areas for any policies aimed at improving health equity and/or community resilience.

Limitations

The methodology used to calculate a Food Stress Index relied on the best available data at the census tract level. However, ACS Census data are sample-based estimates of the population, with standard errors affecting the reliability of the data. Similarly, the measure of food security used to reduce the set of candidate variables also relied on ACS data to determine a model-based estimate of the food insecurity rate at the census tract level. Ideally, we would have a survey-based measure of food insecurity taken at the local level to validate the model and reduce candidate variables; however, the Census Bureau does not publish or release its survey-based food insecurity measures at the sub-county level due to concerns with sample size. Analysis was conducted using the 2017 5-year estimates from the American Community Survey, based on census tracts determined by the 2010 Census. The 2018 ACS data will be released in December 2019, when this analysis could be replicated using the most up-to-date data available.

This analysis should be conducted following the 2020 Census for the Austin/Travis County region, when both the census tract boundaries and data will most accurately reflect the population. Finally, because the Food Stress Index is scaled, scores are relevant only in the context of comparable geographies. Unlike food insecurity rate, which communicates information about a tangible number or share of people who may be facing hunger in absolute terms, the Food Stress Index can only convey information about the *relative* likelihood of risk for a specific neighborhood.

POLICY IMPLICATIONS

Results from the Food Stress Index analysis reflect existing research and anecdotal evidence about trends in poverty, food access, and displacement in Austin/Travis County. Non-white populations concentrated in the Eastern Crescent region tend to have lower incomes and higher barriers to accessing healthy, affordable foods. Results from the Food Stress Index highlight the existing inequities in Austin's food system by capturing multiple dimensions of poverty and food insecurity. The Food Stress Index localizes food insecurity metrics to a neighborhood level, allowing for comparison between specific geographies within the city and county. The index can be recalculated on an annual basis to reflect trends in a rapidly changing city. Food Stress Index scores can also be used to inform conversations around food access and food insecurity related the City of Austin's ongoing Land Development Code revision and rewrite process. Areas facing the greatest risk of continued development and neighborhood displacement are those with greatest financial constraints, including risk of food insecurity. The Food Stress Index can be used to identify the populations most likely to be affected by rezoning and continued development in the city.

Results from this analysis also create opportunities for future research. In addition to recalculating the index on a regular basis to examine trends over time, scores may be calculated for other geographies in the city and/or the greater Central Texas region. To further contextualize the index results within the City of Austin, next steps for research should include surveys and focus groups in high-food stress census tracts to capture the prevalence of self-reported behaviors associated with food stress and food insecurity. Finally, food stress is based on the concept of housing stress; both concepts rely on a "thirty percent" of household income threshold of affordability. Research may be conducted in a local context to examine if housing costs and food costs should use the same standard for an appropriate share of household income, and specifically to determine if thirty percent is an appropriate threshold for assessing affordability in Austin and the surrounding region.

CONCLUSION

Access to food, a key component of food security, is fundamentally an equity issue; the geographic and racial disparities of opportunity in Austin are particularly stark. A single metric that includes household and environmental factors is particularly useful for policymaking and advocacy; by combining data representing a broad set of risk factors and demographic information, the Food Stress Index presents a comprehensive picture of relative opportunity in Austin/Travis County and highlights the populations who are most likely to face food stress and food insecurity.

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